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NATURAL HISTORY OF THE AMERICAN KESTREL IN VENEZUELA

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ABSTRACT.—American Kestrel (*Falco sparverius* L.) populations in southwestern Venezuela achieve highest densities in transitional areas, including deforested ranch lands, grasslands and villages. Field observations focused on pair formation, copulation, territorial defense, production feeding, predation, caching and nesting success. Collected specimens provided information on molt, brood patches, reproductive condition and general morphometrics. Breeding biology and natural history of 22 pairs compared closely with North American populations. Kestrels breeding in Venezuela are smaller than North American individuals, but percent size difference between the sexes is similar in both Americas. South American pairs inhabited small territories, harvested small prey, invested heavily in defense and produced few to no young.

American Kestrel (*Falco sparverius* L.) populations span North, Central and South America from tree line areas of Alaska to open fields of southern Chile (see Brown and Amadon 1968; Cade 1982). There are, however, no published accounts of the biology of kestrels from tropical mainland areas.

This study includes general field observations of kestrels from central to western Venezuela with a detailed natural history of a population in the west. Eleven pairs which resided at El Bayuelo and 11 other pairs from surrounding areas were included in this study. Specific aspects of the biology of kestrels in California and Venezuela were compared.

STUDY AREA AND METHODS

From December 1982 into May 1983 kestrels were studied in central and western Venezuela, including the states of Tachira, Merida, Trujillo, Barinas, Zulia, and Apure. Near Coloncito (Lat./Long. 8°2'N, 72°16'W) in the State of Tachira, a local population of kestrels inhabiting the Hacienda El Bayuelo (Fig. 1) was studied in detail. The 720 ha hacienda is located 9 km north of Coloncito at the foot (30 m elev) of the northwest slope of the Andes. Prior to construction of the Pan American Highway, the area around Coloncito was jungle. In the intervening years virtually all jungle vegetation was cleared for cattle ranching, and only a few small tracts and waterways (canos) remain. Rio Jabillo enters the property from the east. Observations in the field totaled 700 hr.

As part of intensive land management associated with cattle ranching, pastures are tilled every 3-4 mo and replanted by hand with cuttings of Aleman grass which delays natural succession and fortuitously provides habitat for kestrels. Factors promoting kestrel habitation, prey, perches, nest cavities and open vegetation are available in ranching locations.

A dry season from August-September to March-April and a wet season from April-May to July-August characterize weather patterns at the hacienda. High humidity with fluctuating temp. (mid 20°-mid 30°C) was typical Approximately 12 hr of sunlight occur daily.

RESULTS

Kestrels inhabited desert and desert scrub of Barquisemento, high cactus deserts of Estanquez (Merida), and open llanos to the east and west of Cordillera de Los Andes. Birds infrequently inhabited the paramos, jungles, riparian zones (Rio Chama near Merida, Rio Mucuiepe of Zulia), and cloud forests to the north and east of Mericay. Cities of Merida, Valencia, and San Cristobol also supported breeding pairs. Highest numbers of kestrels however, occurred in natural or man-created transitional areas between forests and plains, in villages, agricultural fields, cattle ranches and jungles. Breeding kestrels were found from coastal scapes of Moron to over 2440 m where epiphytes grow red in El Valle. Kestrels have been recorded up to 3000 m (De Schauensee and Phelps 1978).

Morphometric Measurements of Kestrels. Thirty-six kestrels (19 ♂♂, 17 ♀♀) were collected for morphometric study. Wing, tail and tarsi length did not significantly differ between sexes (Table 1). Intra- and inter-sexual comparisons between weights of kestrels in North (NA) and South America (SA) showed a significant difference by sex and area (Table 1). Overall, kestrels in South America are generally smaller. Both populations show a similar percent size difference between the sexes (NA = 88.1%, N = 42 ♂♂, 45 ♀♀; SA = 87.9%, N = 17 ♂♂, 12 ♀♀, *see* also Table 1).

Of the 36 collected specimens, 12 individuals represented 6 breeding pairs (Table 2). Individuals in molt were observed from December to May. During

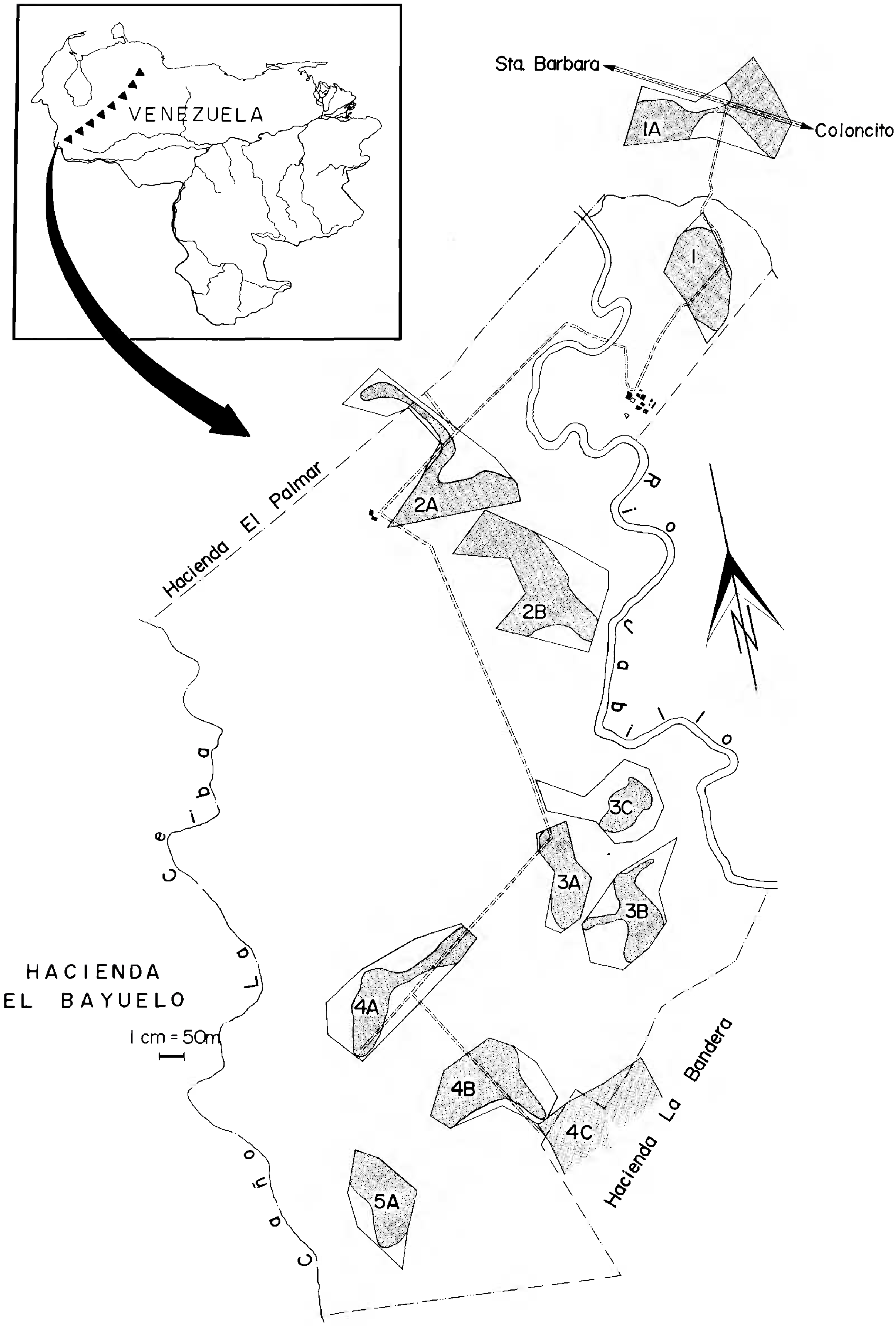
VENEZUELA
Sta. Barbara
Coloncito
IA
I
2A
2B
3A
3B
3C
4A
4B
4C
5A
Hacienda El Palmar
Hacienda La Bandera
HACIENDA EL BAYUELO
1 cm = 50m
Caño La Ceiba

Table 1. Student's *t*-Test comparisons of morphometric measurements of the sexes of American Kestrels in Venezuela and between Venezuelan and North American kestrel populations.

	♂				♀			
	$\bar{x}$	S.D.	N	*P*	$\bar{x}$	S.D.	N	*P*
				Venezuela				
Weight (g)	95.0	7.6	17		108.1	6.2	12	<0.001
Wing (mm)	181.5	6.5	19		185.4	11.3	17	NS
Tail (mm)	130.1	6.6	19		132.9	12.1	17	NS
Tarsus (mm)	38.8	2.0	19		39.1	1.9	17	NS
				North America				
Weight (g)	103.7	13.5	42	<0.001	117.7	17.7	45	<0.05

this period, males showed less molting in flight feathers than females (Table 2). In both sexes brood patches formed early in the breeding cycle; at least several weeks before eggs were laid. In two females brood patches had formed before the ova had begun to enlarge (SJSU-MBM #6033) or fully develop (SJSU-MBM #6037). Their mates (SJSU-MBM #6044 and SJSU-MBM #6065) had formed brood patches slightly later. One female (SJSU-MBM #6041) however, failed to produce eggs or a brood patch, while her mate of several months (SJSU-MBM #6039) possessed enlarged gonads and slightly developed brood patches. Brood patches began to involute late in the breeding cycle (April–May).

Breeding Biology. Kestrels in Venezuela occupy and defend territories (Fig. 1) in December and January, but by February pairs are established. Kestrel territories at El Bayuelo averaged 12.2 ha (S.D. = 4.4; N = 10) in size (*see* Table 3). Not all pairs however, breed, and 3 of 11 pairs remained in the courtship phase for at least 22 wk. One pair at El Bayuelo associated for 3 mo but failed to form brood patches or produce eggs.

Early in pair formation, kestrels occupied extensive areas, including all or part of an eventual territory. Exposure on high perches, mutual avoidance, vocalizations and defense were associated with a territory. Active defense included "klee" vocalizations (Willoughby and Cade 1967), attacks with pendulum dives (Balgooyen 1976) or chases which were direct or undulating in pattern. Interspecific behavioral encounters of kestrels involved 29 species, 17 of which were raptors (58.6%) and 8 species (27.6%) represented food competitors (Table 4). No response was recorded for 22.2% of the encounters. Interactions with raptors accounted for 90.0% of pair response time. Sexes did not differ statistically in number of encounters. However, males appeared to react longer and with more vigor than females when both responded to encroachment.

Copulation. Copulations were observed anytime from 2 January in Barinas to 17 April at El Bayuelo. Of 95 copulation attempts 57% (N = 54) were identified as to which sex initiated copulation. Females initiated copulation 41% of the time by moving toward their mate, or by posturing (Balgooyen 1976).

Incomplete copulations (no cloacal contact) occurred in 14 of 54 attempts. Females held their tails to the left during copulation 63.5% (N = 66) of the time. Mean duration of 74 complete attempts was 6.7 s (S.D. = 2.7 s). Chitter, whine, and whine-chitter vocalizations (Willoughby and Cade 1967) were given during copulation. At El Bayuelo males more frequently chittered and females were more likely to whine. High intensity chittering by males was associated with thrusting. In general vocalizations of any kind throughout the season were infrequent and brief in duration.

Prey Transfer. Food provisioning by males is an integral part of pair formation and maintenance and

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Figure 1. Breeding territories of American Kestrels at hacienda El Bayuelo, Venezuela. Areas of high occupancy are shaded within defended borders. Territories were determined by noting kestrel perches and sites of defense which were plotted on a map (scale 1:5000). A compensating polar planimeter measured the maximum area of territorial polygons. (Darts represent the Andes Mountains.)

Table 2. Reproductive characteristics of 6 breeding pairs of kestrels in the States of Tachira, Zulia, and Apure, Venezuela.

State	Pairs	Date Collected	Weight (g)	Molt	Brood Patches (mm)	Testes L (mm) R (mm)	Ovary
Tachira	♂ 34	31 Mar	100	none	small 13 × 9	6.5 × 5.0 4.0 × 4.0	
	♀ 35		116	P #6 L/R in quill	none		3 ova; small (1 week of prod. feeding)
Tachira	♂ 30	17 Mar	100	4th primary L/R new		6.0× 3.0 5.5 × 2.5	
	♀ 31		105	tail	19 × 25		3 corpora lutei (3 young)
Tachira	♂ 44	8 Apr	101	none		3.5× 3.0 3.0× 2.0	
	♀ 45		109	none	35 × 20		2 corpora lutei (2 females fledged: female 46 = 103 g female 47 = 124 g)
Tachira	♂ 54	16 Apr	105	none	none	7.0× 4.0 6.0×3.5	
	♀	Not coll.					
Zulia	♂ 56	15 Apr	98	slight body molt	regress: 28 × 30	(small) 2.5 × 3.0 1.5 × 1.0	
	♀ 55		106	4th R/L primary	29 × 20		2 corpora lutei
Apure	♂ 9	12 Feb	88	none	new, incomplete	6.5 × 4.0 4.5 × 2.5	
	♀ 10		118	5 pri. new L/R	35 × 27		4 ova, fat deposits, 6.5 mm to 11.5 mm
Apure	♂ 16	12 Feb	87	none	starting	5.0 × 3.5 4.0 × 2.5	
	♀ 15		96	4 pri. new 5 in quill	3 × 18		not developed

Table 3. Size of defended territories for several American Kestrel populations.

Locality	Area (km^2)	N	Reference
E. Bayuelo, S.A.	0.12	10	Balgooyen (this study)
Quebec	0.24	20	Bowman and Bird (1986)
Jamaica	0.44	6	Cruz (1976)
Utah	0.67	12	Smith et al. (1972)
California	1.20	43	Balgooyen (1976)
Illinois	5.06	4	
Wyoming	5.06	22	Enderson (1960)
Michigan	5.86	—	Craighead and Craighead (1956)
$\bar{x}$	2.33		

could provide energy for egg production (see Balgooyen 1976; Coonan 1984). As the female becomes more sedentary and foregoes hunting, an active period of "production feeding" begins by the male.

Prey transfers among pairs at El Bayuelo began in late January. By frequency insects and lizards constituted 97.6% of the transferred prey; insects alone comprised 50.8% (Table 5). Two non-producing pairs at the hacienda continued production feeding for more than 4 mo. The time of transition to extensive male provisioning ranges from 1 or 2 d to several days or weeks for most pairs, and occurred a few weeks before eggs were laid.

Observations of successful breeding pairs showed a bias of augmented lizard consumption in female diet. Females captured lizards at a percent biomass

Table 4. Encounters of American Kestrels at El Bayuelo, Venezuela

	BEHAVIORS													
	ENCOUNTERS		RESPONSE TIME		SEX		CALLS[2]			DISPLAY[3]				
SPECIES	(R)[1]	(NR)	(SEC.)	MEAN	♀	♂	S	K	C	D	P	R	C	W
Raptors														
Black Vulture (*Coragyps atratus*)		1			1									
Turkey Vulture (*Cathartes aura*)	4	3	25	6.2	2	4				3		1		
Black-shouldered Kite (*Elanus caeruleus*)	13	10	120	9.2	7	9				11	2			
Pearl Kite (*Gampsonyx swainsonii*)	2	1	25	12.5	1	2				2				
Swallow-tailed Kite (*Elanoides forficatus*)	1		5		1			1		1				
Snail Kite (*Rostrhamus sociabilis*)		2			2									2
Roadside Hawk (*Buteo magnirostris*)	17	1	755	44.4	7	12	10	6	1	3	12	2		
Gray Hawk (*Buteo nitidus*)	4		1010	252.5	1	4					4	1		
Savanna Hawk (*Heterospizias meridionalis*)	19	1	1355	71.3	11	17	9	10		2	17			
Common Black Hawk (*Buteogallus anthracinus*)	2		25	12.5	1	1								2
Laughing Falcon (*Herpetotheres cachinnans*)	1		70		1	1		1		1				
Barred Forest-Falcon (*Micrastur ruficollis*)	1		360		1			1		1				
Yellow-headed Caracara (*Milvago chimachima*)	15	5	225	15.0	7	15	9	1		2	8		2	3
Crested Caracara (*Polyborus plancus*)	13	6	60	4.6	8	8	4	2	13					
Bat Falcon (*Falcon rufigularis*)	1		150		1	1		1	1				1	
Aplomado Falcon (*Falco femoralis*)	4		605	151.2	2	3					1			3
American Kestrel	12	5	145	12.1	12	14				1		1		7
N =	109	35	4935		66	91								
% Total =	68.6	77.8	90.0		73.0	74.0								
Non-Raptors														
Cattle Egret (*Bulbulcus ibis*)	7	3	45	6.4	3	6				4	2	1		
White Ibis (*Eudocimus albus*)	1		120		1									1
Southern Lapwing (*Vanellus hilensis*)	2		40	20.0		2				2				
Bare-eyed Pigeon (*Columba corensis*)		1												
Chestnut-fronted Macaw (*Ana severa*)	6		60	10.0	3	4				5	1			
Yellow-headed Parrot (*Amazona ochrocephala*)	9		90	10.0	5	7				9				
Orange-winged Parrot (*Amazona amazonica*)	5	1	55	11.0	2	3				5				
Smooth-billed Ani (*Crotophaga ani*)	12	5	65	5.4	7	6	7			9	3			
Lineated Woodpecker (*Dryocopus lineatus*)	3		40	13.3	2	1				3				
Tropical Mocking bird (*Mimus gilvus*)	2		10	5.0		2				2				
Oriole (*Icterus* spp.)	1		10		1		1				1			
Red-breasted Black Bird (*Leistes militaris*)	2		15	7.5	1	1				2				
N =	50	10	550		25	32								
% Total =	31.3	22.2	10.0		27.5	26								
Totals =	159	45	5485		91	123								

[1] R = Response, NR = No response
[2] S = Silent, K = Klee, C = Chitter
[3] D = Direct chase, P = Pendulum attack, R = Retreat, C= Circle, W = Watch

Table 5. Predation and provisioning by American Kestrels at El Bayuelo, Venezuela.

	♂					♀					
			Biomass					Biomass			
Prey	N	% Capture	Wt. (g)	%	Transfer Prey N	N	% Capture (N = 129)	Wt. (g)	Wt. Transfer	%	% Transf.
Insect[1]	269	78.9	188.3	31.3	63	114	88.3	79.8	44.1	47.0	11.2
Lizard[2]	69	20.2	414.0	68.7	58	15	11.6	90.0	34.8	53.0	88.8
Snake	1	0.8			1						
Mouse	1	0.8			1						
Bird	1	0.8			1						
Unknown[3]	29				11	7					
Cache[3]	11					2					
Failed	146					49					
	527					187					

	♂			♀			
Predation	$\bar{x}$	S.D.	N	$\bar{x}$	S.D.	N	P
Perch Height (m)	8.1	5.0	269	7.2	3.3	72	NS
Distance to Prey (m)	25.0	19.7	407	25.3	16.2	149	NS
Time on Ground (sec)	7.9	10.4	246	5.9	6.7	85	NS
Perch Height & Insect Capt. (m)	8.6	5.8	157	7.2	3.2	60	NS
Perch Height & Lizard Capt. (m)	8.6	4.8	28	9.8	1.4	7	NS

[1] Mean weight of insect = 0.7 g.
[2] Lizard (3 spp.) = 6.0 g.
[3] Not included in calculation.

of 53.0 before provisioning (Table 5). Production feeding allowed females to consume a preponderance of lizards, representing 89% by biomass. Males therefore, increased the female's diet of lizards by some 36%. From 2 closely observed pairs which did not produce eggs, none to few lizards were captured or transferred to the females. Both adult females were frequently seen "begging" for food and hunting for themselves. Upon examination, these females exhibited none to slight ovarian development. Apparently these individuals were not receiving sufficient amounts of food for egg production.

Nest Sites. Palm, Ceiba (*Ceiba pentandra*) and Araguaney (*Tabebuia chrysantha*) provided nest sites for breeding pairs. Excavations by woodpeckers (*Melanerpes* spp., *Dryocopus* spp., *Campephilus* spp.) provided protected cavities. Mean height of 22 nests was 7.8 m. Palms held 12 of 22 nests under study. Nest entrances favored a N–S aspect which faces into prevailing winds from the north and south.

Pairs 1A and 2A lost their nests to wind and fire, respectively. Both pairs renested in the same kind of trees and new nests also faced into the wind: entrance changed from SW to SE and from SW to N, respectively. Topography, botanical features, and perhaps adjacent conspecific pairs were factors in nest site location (see also Bowman and Bird 1986). Pair 3C nested in a palm which also contained nests of Yellow-headed Parrots (*Amazona orchocephala*) and Tropical Screech Owls (*Otus asio choliba*).

Eggs and Young. Because of the difficulty of climbing nest trees, especially palms, relatively few data were recorded for kestrel eggs and young. One clutch of 4 eggs ($\bar{x}$ Width = 27.8 mm, $\bar{x}$ Length = 35.8 mm), pair 4A, lost an average of 5.2% of the total weight (58–55 g) from day 13–20 of incubation.

Counts of fledged young from 9 nests suggest a production of 2–3 young/pair. Pair 3C produced 3 eggs, hatched 1 male and 2 females but fledged only 1 of each sex. From direct counts on collected females, 12 females possessed 44 *corpora lutei*, suggesting 3.7 (range 2–5) probable eggs/females. From

5 nests in El Bayuelo, the date of first egg laid ranged from 17 January–14 February (29 d).

Predation. Insects and lizards comprised the majority of the prey (Table 5). Kestrels hunted almost solely from perches. Only incidental occurrences of hawking or hovering flights were recorded. Hunting was reduced during the "hot" or mid-day period from 1200–1500, unlike kestrels in California which maintained an even rate of daily hunting activity (Balgooyen 1976). Both populations captured prey with similar success (California = 70%; Venezuela = 73%). During periods of high temps (36°C), kestrels in Venezuela perched in the shade, gasped and panted, and held contour feathers tightly to the body. Wings were kept open.

From 100 consecutively timed prey deliveries to the nest, kestrels in California captured prey items an average of 5.1 min each (S.D. = 5.6 min). In a similar test of 159 prey items, kestrels in Venezuela secured prey every 10.8 min (S.D. = 13.1), the difference being highly significant ($t = 4.14$; $P = 0.001$). On a daily basis this translates to 175 prey items/15 hr in California being provided by the adults compared to a maximum of some 70 prey items/12 hr being brought to the nest in Venezuela.

Kestrels perched an average of 7.7 m above the ground (N = 341). Distance from falcon to prey averaged 25.2 m (N = 556). For either sexes perch height and strike distance were not correlated (r = 0 22, N = 345). Mean successful capture distance was significantly shorter (P = 0.001) than the mean failure distance (28.7 m; S.D. = 20.3, N = 266 vs. 23.0 m, S.D. = 16.2, N = 379). Comparison of the mean capture distance of falcon to lizard (34.2 m, S.D. = 20.7, N = 48) versus that of insects (21.6 m, S D. = 16.4, N = 329) indicates that insects were expectedly more difficult to obtain or detect than lizards as strike distances increase ($t = 3.3$; $P = 0.001$). Kestrels (either sex) did not however, change their perch height when hunting lizards or insects (lizards $\bar{x} = 8.7$ m, S.D. = 4.8, N = 35; insects $\bar{x} = 8.2$ m, S.D. = 5.7, N = 217) (Table 5).

Of 714 observed strikes by kestrels, males accounted for 527 attacks. Differences in sexual roles during breeding biases hunting frequency in favor of males. Captures were successful on 72.7% of all attempts, and there was no significant differences between the sexes in capture success.

Caching. All pairs and both sexes practiced caching. Cached items were exclusive to the individual making the deposit. While most individuals utilized fewer sites, the male of pair 1 utilized up to 11 cache sites. Unlike kestrels in California, most caches in Venezuela were located on the ground (58%, N = 24), contained anolid and iguanid lizards (96.4% N = 28 caches) and were emptied by afternoon. Other caching sites included fence posts, telephone poles, dead branches, and epiphytes.

Dust Bathing. In the evening (time range 1716–1901 H, N = 6 females, 2 males) kestrels sought dirt roadways to dust bath. Typically, an individual lands on a roadway and walks to a spot where cattle or vehicles have loosened the surface. While crouched on bent tarsi and with the head lowered, an individual scratches and flaps to bring up dust. The tail is held open. Rotation or side to side rocking of the body was commonly observed. Air temperatures ranged from 32–34°C; one substrate recording reached 37.2°C. After dusting, females commonly flew to the nest cavity.

DISCUSSION

Despite differences in botanical composition between breeding territories in North and South America, kestrels inhabit physiographically comparable landscapes. Grassland (pasture)-forest ecotone provides kestrels with nesting cavities, open flatland vegetation in which to hunt, numerous perches and suitable prey. In addition to habitation events in the kestrel's natural history appeared to follow a similar pattern in both areas. Noteworthy in comparison included the establishment of a defended territory, pair bonding, production feeding, female centripy, selection of a nest site, vocalizations, hunting, care and defense of young and caching. Apparent differences were quantitative and included kestrels from Tachira inhabiting relatively small territories, hunting and provisioning at lower rate, capturing fewer mammals and birds, defending more against interspecific food competitors, and generally producing fewer young than kestrels in California.

While avoiding midday periods, kestrels in Venezuela preyed on insects and small lizards in comparatively small territories (Table 3), suggesting a high prey density (Lack 1954; Craighead and Craighead 1956; Stenger 1958; Gill and Wolf 1975; Newton 1976, 1979; Meyers et al. 1979; Village 1982; Bowman and Bird 1986). While predation success is similar in both areas, rate of feeding young by Venezuelan adults is relatively low when compared to rates in California (for invertebrates 5 min vs. 11 min). Apparently, low prey density, few young being produced at El Bayuelo or perhaps both factors account for a low feeding rate.

Kestrels of El Bayuelo capture small lizards and invertebrates, but rarely take mammals or birds. Personal observation of all territories suspects unavailability. At El Bayuelo a random sample of 65 snap trap-nights over the course of the study resulted in no small mammals captured. Likewise, small birds were very rarely seen in kestrel territories. Both Jenkins (1969) in Costa Rica and Cruz (1976) in Jamaica reported none to few mammals and birds in kestrel territories, and, consequently, insects and lizards constituted the majority of the diet. Kestrels in North America are predators of abundant small and/or large prey during the breeding season (Heintzelman 1964; Smith et al. 1972; Sparrowe 1972; Collopy 1973; Balgooyen 1976; Craig and Trost 1979; Bohall-Wood and Collopy 1987). In Venezuela however, by being predators of small prey, kestrels may not obtain sufficient energy to produce relatively large clutches or, at times, even forego reproduction. One observation from a clutch of 2, showed 1 sibling (103 g) uncommonly below the mean adult female weight of 108 g and the weight of her female sibling (124 g).

Harvesting small prey may not only influence levels of production, but size of territory as well. Kestrel territories from El Bayuelo are only 5.2% the mean size of territories recorded elsewhere (Table 3). Small prey are energy "expensive" and do not allow efficient capture, transport and preparation by kestrels (Newton 1979; Orians and Pearson 1979). Energy expended over distance traveled becomes increasingly prohibitive as payload energy diminishes; thus, relatively small territories and low production. At El Bayuelo, several pairs did not or could not breed. An examination of ovaries suggests insufficient energy intake.

Compared with kestrels in California, Venezuelan pairs frequently drive several insect and lizard-foraging competitors from their territories (Table 4). Cattle Egrets (*Bubulcus ibis*), Southern Lapwings (*Vanellus chilensis*), Smooth-billed Anis (*Crotophaga ani*), Yellow-headed (*Milvago chimachima*) and Crested Caracaras (*Polyborus planus*), Roadside Hawks (*Buteo magnirostris*), Black-shouldered Kites (*Elanus caeruleus*), Savanna Hawks (*Heterospizas meridionalis*), and others were excluded from breeding territories, suggesting a need not to defend young but to protect a prey base. A small territory would facilitate defense. An ecological equation involving frequent territorial defense and capturing small expensive prey is balanced by kestrels inhabiting comparatively small territories and producing few young.

Kestrels in California rarely, if ever, transferred insects. In Venezuela, 23% (63 of 269) of the insects captured were transferred by males. Differences between the 2 populations may reflect unavailability of mammals and birds on kestrel territories in Venezuela as well as the need to provide food to females

In a study conducted near Davis, California, Rudolph (1982) observed 1 kestrel pair expending more energy during production than other pairs. The female regularly hunted, both sexes hunted close to the nest cavity, and both took small invertebrate prey. Rudolph felt that low vertebrate availability was the cause but did not provide the size of the pair's territory. Since only 2 young were produced there could be a limit to energy gained by this strategy in relatively poor territories (see Newton 1976). Except for regular female hunting, a similar pattern was observed in Venezuela.

Kestrels in Venezuela display a breeding biology similar to pairs from North America. Production feeding, female centripy and general role behaviors of the sexes typify kestrels of both Americas. Similarity in natural history of breeding kestrels from North and South America does not reject hypotheses of size, sexual dimorphism (SSD) which are based on laws of energy (see Reynolds 1972; Balgooyen 1972, 1976; Mosher and Matray 1974; c.f. Mueller 1986).

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